Space Weather Technical Forecast

Issued on Saturday, 18 December 2021 at 12:37 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Daily Chance of M-class flares, potentially increasing over the UTC weekend. Chance of high speed stream from a coronal hole by day 4.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the past 24 hours, with only a C2-class flare at 17/1312UTC, originating from sunspot region AR2909 in the southeast quadrant. There are currently six numbered sunspot regions on the visible disc, with the southeastern quadrant seeing the most complex of sunspot regions and strongly polarised. However, rates of growth appear to have slowed down over the past 24 hours. relative to previous days. Most of the sunspot regions appear to be a Beta classification, with the exception of AR2906, which is now Alpha/Axx, with AR2910 also showing signs of further decay, but remains a Beta/Bxo classification. No Earth-directed Coronal Mass Ejections (CMEs) were observed in available satellite imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by the DSCOVR satellite at L1 have been at background levels, after exiting from a high speed stream thought to be from CH32, which is no longer visible on the disc. Solar wind speeds have ranged between 380km/s to 330km/s during the past 24 hours. Density has been around below or around average throughout the period, ranging between 2 and 5 ppcc. The interplanetary magnetic field (IMF) peaked at 5nT, with the all important north-south component (Bz) varied between +4/-3nT. The phi angle was mostly negative (towards the sun) but with more variability into the new UTC day. The net result of the above solar wind measures was Quiet geomagnetic activity during the last 24 hours.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels.
The high energy electron flux (greater than 2 MeV) was at mainly Background levels, with the associated 24-hour integrated fluence well below the Active threshold. A fluence of 1.79e6 was observed at 18/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to continue mainly Low, with the Chance (30%) of further isolated M-class flares, and a Slight (5%) Chance of an X-class flare. Flare probabilities may increase a little in the coming days (to 40 and 10% respectively), with further potential active regions likely to rotate around the east limb, with none of the current active regions on the disc leaving over the west limb.

Solar Wind / Geomagnetic Activity: No CMEs feature in the current forecast period. Earth has recently exited a high speed stream from CH32 to leave Quiet geomagnetic conditions. There is now thought to be a chance of some influence from the small CH36 later in the UTC weekend, perhaps peaking at Active, before reverting to Quiet once again. Finally, there is a possible late peak in activity should CH35 arrive on day 4 (21 Dec), which is signposted by a 5% Slight

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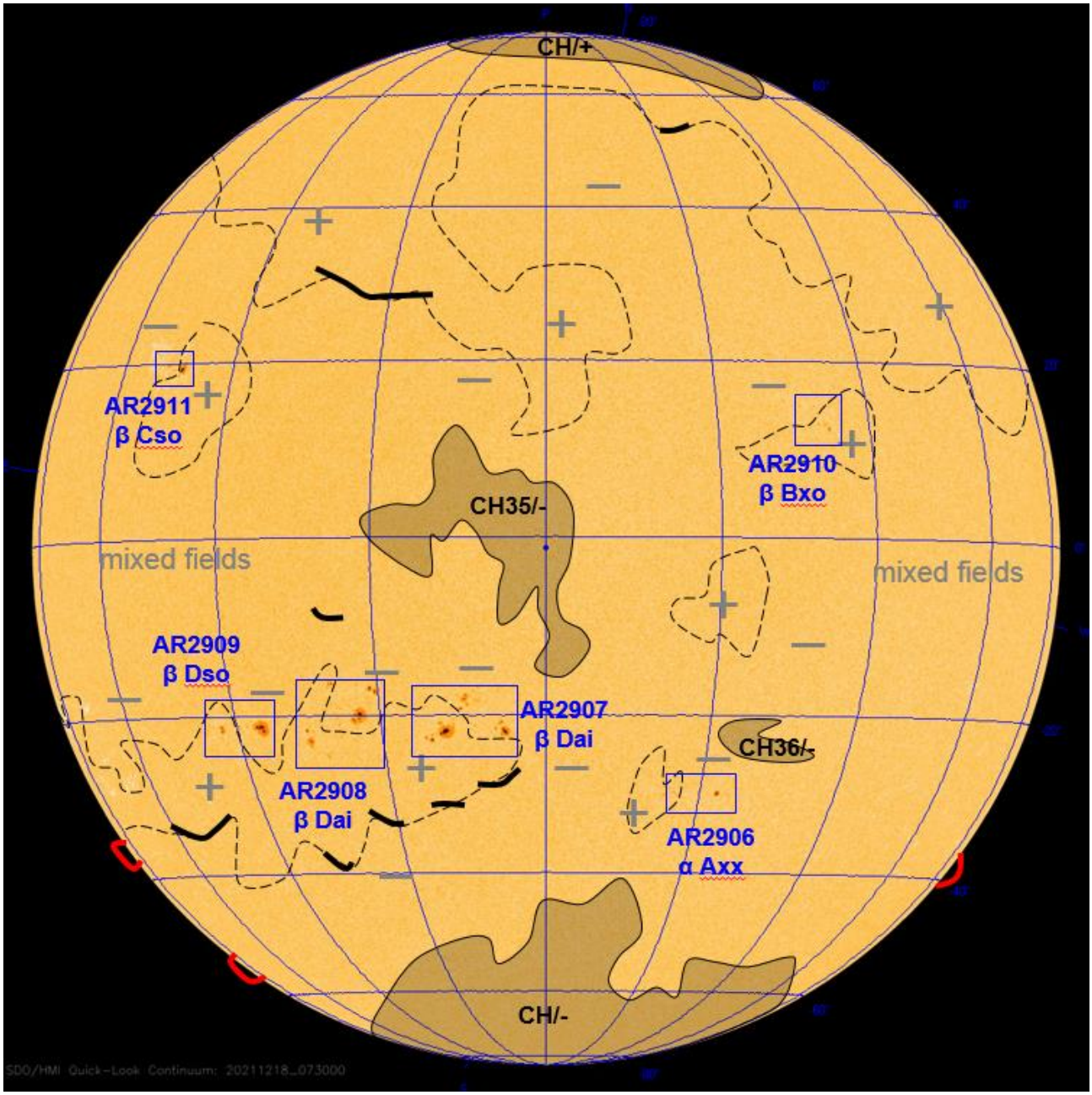
Chance of G1/Minor Storm.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, although with a slight increasing risk as the active regions transit towards the western solar hemisphere.
The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, is expected to be at Background to Moderate levels, perhaps with a slight rising trend in the next day or so. The associated fluence is expected to remain below the Active threshold.

Figure 1. Solar Analysis Valid 18/0730UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in this forecast.
Earth's exit from coronal hole 32 high speed stream to end the working week had been thought to potentially leave the Earth in a slow regime for the coming four days. CH35's (located centre-disc), arrival at Earth is uncertain but will probably fall outside the forecast period (this is due to the lack of analogue data on the previous rotation and no effect at STEREO A as of yet). STEREO A PLASTIC data in the past three days does however suggest a possible modest enhancement to near 500km/s, which may be the result of the much-reduced CH36/-, which is a vestigial remnant of a much larger coronal hole from 27 days ago (reaching the upper-600s of km/s). The emergence of a train of sunspot regions in this location appears to have largely closed the coronal hole, but STEREO A data perhaps implies that it survives in some form.
In a mainly Quiet forecast, there is now considered to be a Chance of some Active intervals later in the UTC weekend, perhaps also lasting into day 3 (20 Dec). CH35 may also make a late appearance, giving a token 5% Slight Chance of G1/Minor Storm on day 4 (21 Dec), although with this being the winter solstice any effect will probably be very muted.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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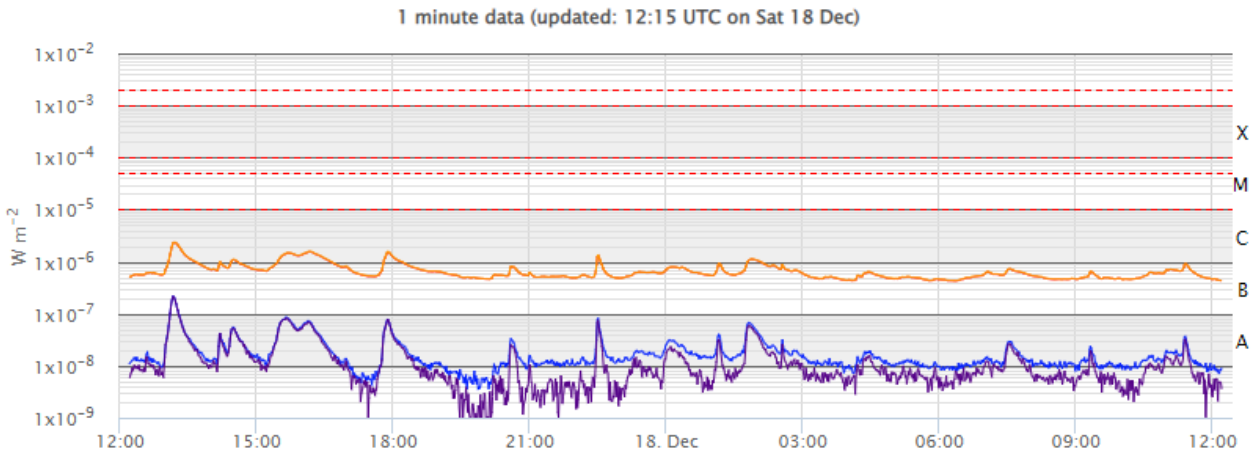
Radio Blackouts - X-Ray Flares:
The current Earth-facing disc is replete with sunspots at present, especially the eastern solar hemisphere. This trend appears to continue onto the far side over the eastern limb, with soundings and STEREO A EUVI 195 imagery both suggesting that several bright flux regions lie narrowly over the horizon. Given that none of the current front-side regions leave the disc in the next four days, any arrivals in the east should add to the risk of X-ray flares. The degree to which this occurs remains to be seen, however the coming UTC weekend should reveal some new regions, which will be analysed once they appear on the Earth-facing disc.
At present, the complexity of the front side groups is still thought to offer a daily Chance of M-class flares and a Slight Chance of X-class, with C-class flares Expected (90%).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	40	40	40
Very Active	R3 to R5 X Class	No	5	10	10	10

Figure 2: GOES X-ray flares for the last 24 hours – minor C-class flares observed from the complexity of sunspot regions currently visible in the east and southeast of the Earth-facing disc.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently expected to remain at Background levels.
Increasing sunspot activity may warrant a slight increase in the chance of S1 radiation storms over the next few days, though at present the most significant active regions are in the eastern hemisphere of the solar disc.

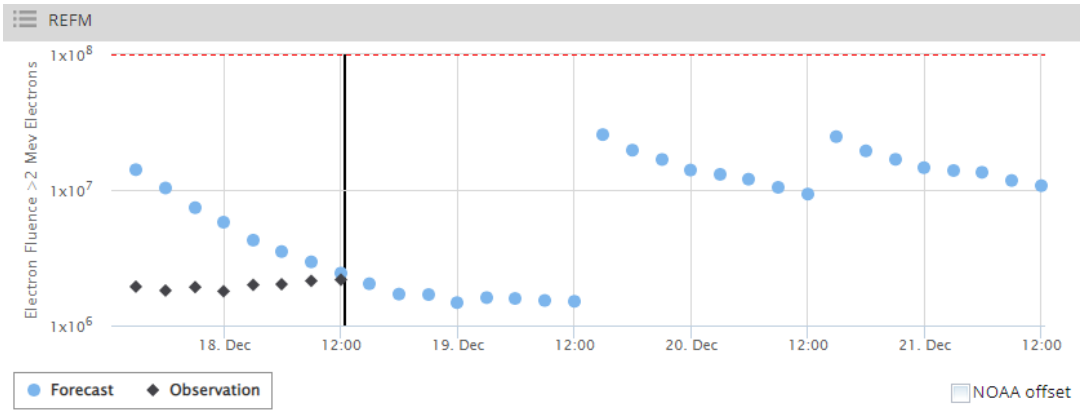
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, is currently at Background to Moderate levels. There has been a very muted response in electrons at GEO to the lifting of geomagnetic activity from CH32 (no longer visible on disc). Therefore, any response in the electrons is now unlikely to occur, but maintaining a very low risk (5%) during the UTC weekend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM observations and forecast.



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